Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6354/2020/1
Applicant	Chevron Australia Pty Ltd
ACN	089 197 757
File Number	DER2020/000038
Premises	Gorgon LNG Project Part of Crown Lease L0077431 Certificate of Title Volume 3158 Folio 477, Part of CO2 Injection Wells Licence 00564-2009-A1744377, and Portion of Lot 3000 on Deposited Plan 91514, being the subject of Easement shown on Deposited Plan 70903 BARROW ISLAND WA 6712
Date of Report	8 April 2020
Status of Report	Final

Table of Contents

1. Definitions of terms and acronyms

In this Decision Report, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
ACN	Australian Company Number
Applicant	Chevron Australia Pty Ltd
BINR	Barrow Island Nature Reserve
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
Decision Report	refers to this document.
Delegated Officer	an officer under section 20 of the EP Act.
Department	means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
Existing Licence	The Licence L9102/2017/1 issued under Part V, Division 3 of the EP Act and in force prior to the commencement of, and during this assessment
Licence Holder	Chevron Australia Pty Ltd
LNG	Liquefied natural gas
m^3	cubic metres
Minister	the Minister responsible for the EP Act and associated regulations
MS	Ministerial Statement
mtpa	million tonnes per annum
NEPC	National Environmental Protection Council

Term	Definition
NEPM	National Environmental Protection Measure
PM	Particulate Matter
PM_{10}	used to describe particulate matter that is smaller than 10 microns (µm) in diameter
Prescribed Premises	has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Reservoir CO_2	as defined in Schedule 2 of Ministerial Statement 800 Reservoir CO_2 is *a gas stream that consists overwhelmingly of carbon dioxide and coming from the acid gas removal units of the Gas Treatment Plant located on Barrow Island. The carbon dioxide will contain incidental associated substances derived from the natural gas and the process used to separate the carbon dioxide from that natural gas.*
Risk Event	As described in *Guidance Statement: Risk Assessment*
$\mu g/m^3$	micrograms per cubic metre

2. Purpose and scope of assessment

Chevron Australia Pty Ltd (the Applicant) hold an Existing Licence to operate the Gorgon liquefied natural gas (LNG) Project (L9102/2017/1). An application (Chevron, 2020a) for a Works Approval relating to the Gorgon LNG Project was submitted on 15 January 2020 to seek approval to:

1. construct and operate long-term infrastructure to capture and re-route flash gas vapours generated by the monoethylene glycol (MEG) regeneration unit to the LNG Plant inlet facilities; and
2. continue the current activity of combusting MEG flash gas vapours at the wet gas ground flare, via continued operation of existing infrastructure constructed under Works Approval W6199/2018/1, until the long-term re-routing infrastructure is in operation.

The Application was submitted under s53 of the EP Act as it alters the nature or volume of waste emitted from the Premises. The Applicant also submitted an updated Best Practice Pollution Control Design Report (Chevron, 2020b) and a revised Air quality Monitoring Program (Chevron 2020c) which fulfil relevant *Environmental Protection Act 1986* (EP Act) Part IV requirements for the proposed works. Table 2 lists the documents submitted during the assessment process.

Table 2: Documents and information submitted during the assessment process

Document/information description	Date received
Email titled: *Gorgon Submission: MEG Flash Works Approval Application* including attachments: • Application Form (MEG Flash Gas Works Approval) • Best Practice Pollution Control Design Report – Rev 3	15 January 2020
Email titled: *Chevron RFI Response: APPLICANT NOTIFICATION - W6354/2020/1* including attachments: • Ambient Air Quality Monitoring Program – Graphs (PDF) • MEG Flash Gas Modelling Files	21 January 2020
Ambient Air Quality Monitoring Program – Data (Excel)	24 January 2020
Revised Air Quality Management Plan – Rev 2.3 (DWERDT265127)	12 March 2020
Email titled*: Part V* providing overview of the flare/purge system and including a process flow diagram for streams entering the Wet Gas Flare (attached).	31 March 2020

3. Background

The Gorgon LNG Project is located on Barrow Island; an A-Class Nature Reserve (Crown Reserve 11648) situated 85 km north-west of Onslow. Natural gas is extracted from the Gorgon and Jansz-Io gas fields (situated 65 and 130 km off the west coast of the island) and transported to the gas treatment plant (GTP) on Barrow Island for processing. The GTP produces LNG via three LNG processing trains with a maximum annual throughput of 18 mtpa (15.6 mtpa nameplate design throughput). Lesser amounts of condensate and domestic gas (DomGas) are also produced.

Table 3 lists the prescribed premises categories that are included on the Existing Licence L9102/2017/1.

Table 3: Prescribed Premises Categories in the Existing Licence

Classification of Premises	Description	*Approved Premises production or design capacity or throughput*
Category 10	Oil or gas production from well: premises, whether on land or offshore, on which crude oil, natural gas or condensate is extracted from below the surface of the land or the seabed, as the case requires, and is treated or separated to produce stabilised crude oil, purified natural gas or liquefied hydrocarbon gases.	LNG: 18 million tonnes per Annual Period DomGas: 300 TJ/day Condensate: 1 million tonnes per Annual Period
Category 34	Oil or gas refining: premises on which crude oil, condensate or gas is refined or processed.	
Category 52	Electrical power generation: premises (other than premises within category 53 or an emergency or standby power generating plant) on which electrical power is generated using a fuel.	585.5 MW
Category 54	Sewage facility: premises — (a) on which sewage is treated (excluding septic tanks); or from which treated sewage is discharged onto land or waters.	1,385 m^3/day
Category 62	Solid waste depot: premises on which waste is stored, or sorted, pending final disposal or re-use.	240,000 tonnes of stockpiled concrete Waste per Annual Period 52,050 tonnes of other solid Waste per Annual Period
Category 73	Bulk storage of chemicals, etc.: premises on which acids, alkalis or chemicals that – (a) contain at least one carbon to carbon bond; and (b) are liquid at STP (standard temperature and pressure), are stored.	1,090 m^3

4. Overview of Premises

4.1 Operational aspects

4.1.1 LNG production and MEG recovery overview

The LNG/DomGas production process commences with Jansz-Io and Gorgon gas field feed arriving at the inlet processing facility slug catchers, which segregate incoming fluids into three phases (gas, condensate and aqueous). The majority of the gas phase is sent to the LNG trains for processing and a portion is sent to the DomGas plant. The condensate phase is directed to a condensate stabilisation unit where light hydrocarbons are stripped out to produce condensate which is shipped as a product, commonly in the form of a diluent for heavier crude oils (Figure 1).

The aqueous phase comprises rich (water-saturated) MEG and this is sent to a MEG regeneration unit, which removes water and salts. Recovered lean-MEG, which is reused to inhibit hydrate formation in feed gas pipelines, is returned to the production wellheads via dedicated MEG utility pipelines. Remaining wastewater is disposed of via deep well injection. The MEG regeneration process produces a continuous stream of flash gas vapours primarily containing carbon dioxide (CO_2) (83 mol%), hydrocarbons (16.6 mol%) and nitrogen (N_2) (0.8 mol%). The stream also contains mercury (13,000 µg/m^3) and BTX (benzene, toluene and xylene) (300 ppm).

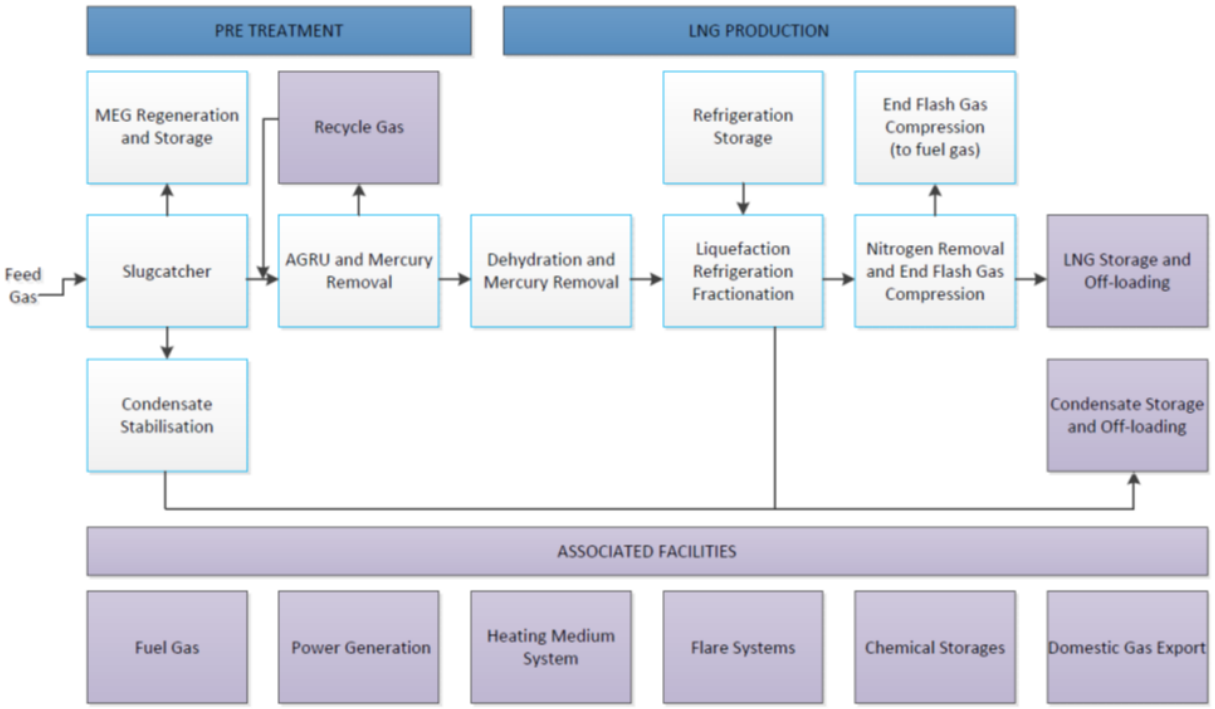

Figure 1: Gorgon LNG process

4.1.2 Original design intent for MEG flash gas vapour capture and disposal

The original LNG Plant design, as described in the Gorgon Best Practice Pollution Control Design Report, included MEG flash gas vapours being directed to the LNG Plant inlet facilities for treatment via the LNG production process. The purpose of this design is to enable the MEG flash gas vapours to be captured and treated to remove non-hydrocarbon components (mercury, BTX and CO_2), and recover the hydrocarbons components. As per the LNG process illustrated in Figure 2, mercury within the vapours will be removed in the mercury removal units (MRUs) or drain points prior to the gas reaching the acid gas removal units (AGRUs). The AGRUs will capture CO_2 and BTX from the vapours and separate it from the hydrocarbons within the vapours. Captured CO_2 will be directed to the CO_2 Injection System for sequestration and the remaining hydrocarbon gas will be processed through the existing LNG processing facilities.

The design also included a contingency to provide for venting of the MEG flash gas vapours from the MEG flash gas compressor discharge point (Discharge point A11 on the Existing Licence), only when the CO_2 Injection System was off-line.

Operation of the CO_2 Injection System was delayed beyond the commencement of operation of the LNG Plant, due to technical issues with the infrastructure, which meant that the original design intent was not able to be implemented. Therefore the Existing Licence for the Premises initially authorised MEG flash gas vapours to be vented via the MEG flash gas compressor.

Some occupational health and safety concerns were raised in 2018 associated with venting of

MEG flash gas vapours via the MEG flash gas compressor. As a result, in late 2018 Chevron sought approval to re-route the MEG flash gas vapours from the MEG flash gas compressor to the wet flare for combustion to alleviate the concerns. In April 2019, Chevron was granted works approval W6199/2018/1, which authorised the construction of infrastructure to re-route MEG flash gas vapours to the wet gas flare, operation of the infrastructure, and discharge of resulting emissions via the ground flare for the duration of the works approval (expires on 10 April 2020).

4.1.3 Implementation of MEG flash gas vapour capture and disposal original design

The Applicant has now completed design work and commenced planning for the construction of infrastructure required to implement the original LNG Plant design for capture and treatment of MEG flash gas vapours as described in section 4.1.2. The MEG flash gas vapours will be routed to the Condensate Stabilisation Compressors from where they will be directed to the LNG Plant inlet so they can be incorporated into the LNG Plant feed and processed via the MRU, AGRUs (including sequestration of captured CO_2) and LNG production facilities. Operation of the proposed infrastructure will result in there being no routine MEG flash gas vapour emissions to air during normal operations. A process flow diagram for the MEG flash gas vapours is included in Figure 2.

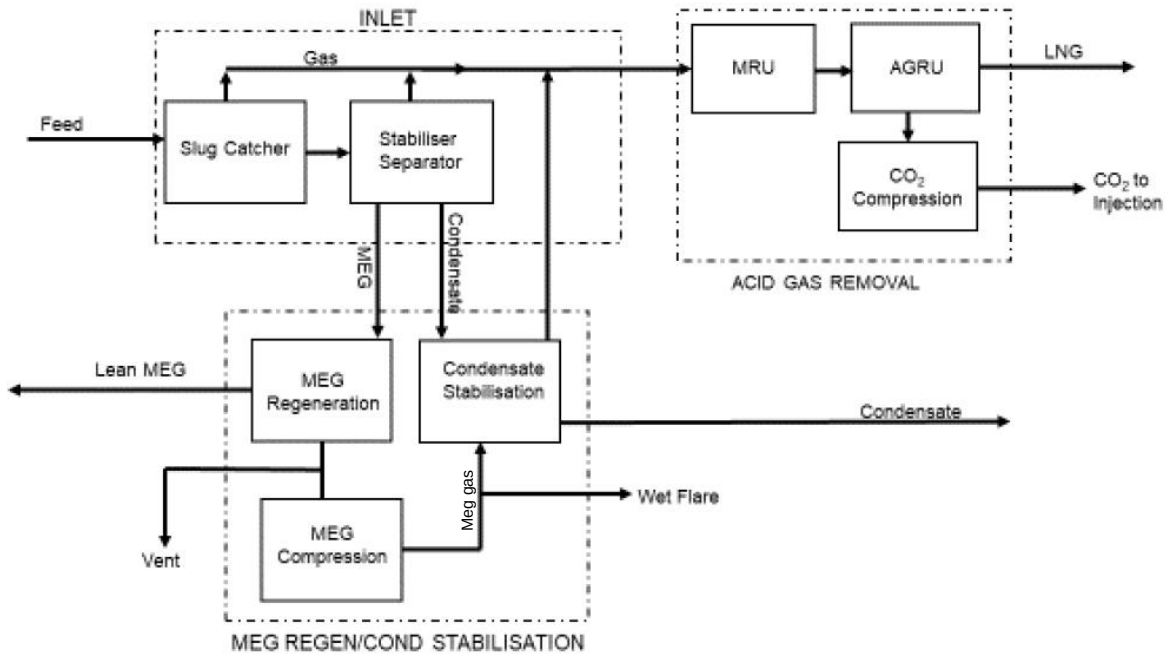

Figure 2 Process flow diagram of MEG flash gas vapour movement through long-term infrastructure

This long-term solution, which comprises the works associated with the Application, requires additional piping, associated valves and instrument control systems to be installed to re-route the MEG flash gas vapours to the Condensate Stabilisation Overhead Compressors on LNG Train 1 and Train 2 for processing through the LNG Plant inlet facilities (Figure 3). The Applicant intends to commence installation of this infrastructure in early to mid-2020. Once the infrastructure is operational, there will be no routine flaring or venting of MEG flash gas vapour. However, the ability to direct the vapours to the flare or vent them from the MEG flash gas compressor will be retained as a contingency measure for periods when the CO_2 Injection System and/or the Inlet or the MEG regeneration/condensate stabilisation systems (Figure 2) are not available due to upset conditions, shutdowns or start-ups.

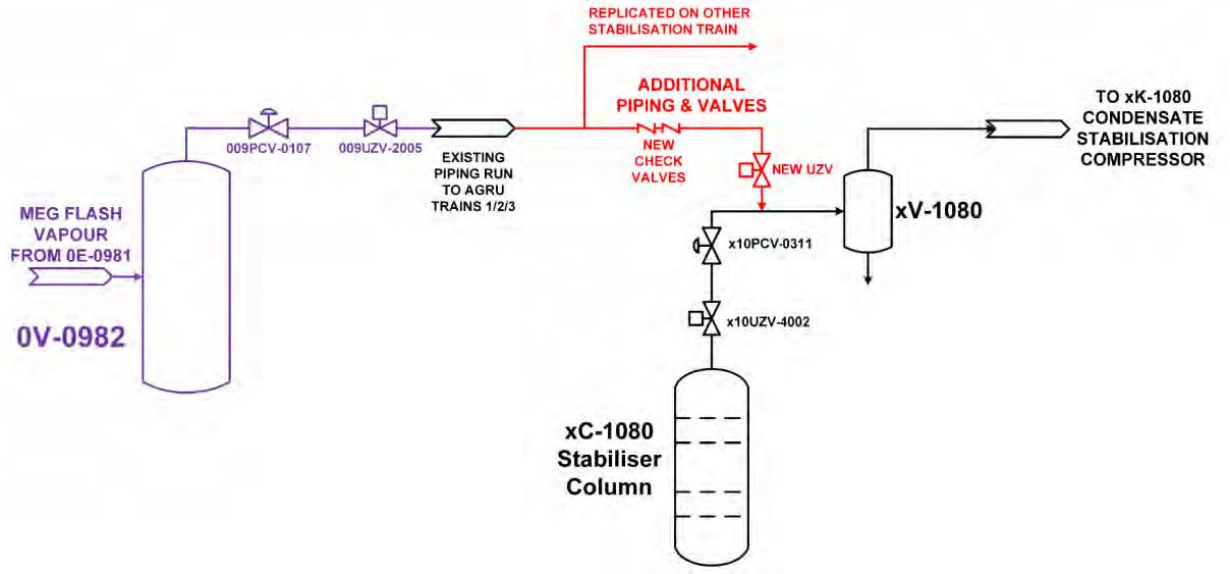

Figure 3 Overview of Long-term Infrastructure (shown in red)

4.1.4 Combustion of MEG flash gas vapour via the ground flare

As described in section 4.1.2, MEG flash gas vapours are currently routed to the wet gas flare where they are combusted and resulting emissions are discharged to air via the flare (as authorised by W6199/2018/). Construction and commissioning of the long-term infrastructure described in section 4.1.3 is not expected to be complete until Q2 2021, and not operational until Q3 2021. The Applicant has therefore requested approval to temporarily continue routing MEG flash gas vapours to the ground flare system until the long-term infrastructure is operational. This is expected to minimise the requirement for venting over this interim period and reduce overall emissions to air from the premises in comparison to venting the MEG flash gas vapours over the period.

An explanation of the general operation of the wet gas flare as it relates to the combustion of MEG flash gas vapours via the flare is included below.

The wet gas flare collects potentially wet hydrocarbon sources (via a collection header) that are either from an emergency relief (e.g. pressure safety valves) or required to be collected to prevent an emergency relief during an upset operational condition (e.g. pressure control valves). The collection header is routed to a knock-out drum to collect and remove any liquids. The remaining gas is then sent to the flare for combustion.The flare includes various systems to ensure safe operation of the flare system.

The systems which are part of the safe operation of the flare include flare pilots (continuous burning of a small amount of gas) which ensures that the gas from any flaring event is ignited. Flares are susceptible to flashback and explosion if not effectively purged to keep oxygen from entering the flare stack through the flare tip. It is therefore also necessary to provide a low level continuous purge of the flare header system with fuel gas to ensure oxygen does not enter the system, and maintain a sufficient velocity at the flare tip to prevent oxygen ingress and backburning within the tip, so that safe ignition of the flare can occur. Based on these operational requirements, under normal operating conditions, there is a constant flow of fuel gas to the wet gas flare tip to maintain two pilot flames on each burner. There is also constant purge of fuel gas through the wet gas flare header to provide a positive pressure to minimise oxygen ingress into the flare. Therefore, the pilot light and purge system are considered to be part of the flare system.

The infrastructure constructed in accordance with W6199/2018/1 routes MEG flash gas

vapours from the MEG flash gas compressor to the wet ground flare header system. Within the header system the MEG flash gas vapours are co-mingled with a range of other ancillary/fuel gas streams to make up the purge gas which is used to continuously purge the flare header. The MEG flash gas vapours therefore substitute a proportion of purge gas that would otherwise be required from the LNG plant. On average the MEG flash gas vapours represent approximately 27% of the routine purge gas stream and are part of the constant fuel gas supply required for normal operation of the flare. The applicant intends to continue combustion of the MEG flash gas vapours, as part of the flare purge gas, until the long term infrastructure is operational.

4.2 Infrastructure

The existing and new infrastructure, as it relates to this Application, is detailed in Table 4 and with reference to the Site Plan (Figure 4). Table 4 lists new infrastructure associated with the long-term solution of re-routing of MEG flash gas vapour to the LNG Plant inlet facilities, and the existing infrastructure associated with the long-term solution and the continued flaring of MEG flash gas vapour.

Table 4: New and existing infrastructure to support the re-routing of MEG flash gas vapour

	Infrastructure	**Site Plan Reference**
Existing Infrastructure		
1	MEG Recovery Units and compressors	Figure 4
2	Condensate Stabilisation Compressor Units (for LNG Trains 1 and 2)	
3	Ground flare system (Discharge Point 8)	
4	LNG Plant Inlet facilities (slug catchers)	
New infrastructure		
1	Piping from MEG flash gas tie in point to condensate stabiliser tie in points 1 and 2: • Approximately 440.5 metres (m) of 200mm (8”) diameter, schedule 40 stainless steel pipe; and • Approximately 80 associated pipe supports to link the MEG flash compressor output to the first stage knock out drum of the Train 1 and Train 2 Condensate Stabilisation Overhead Compressors.	Figure 4
2	Valves: • Approximately two 200mm stainless steel shut down valves (one per Stabilisation Compressor unit); • Approximately four 200mm stainless steel check valves (two per unit); • Approximately six 200mm stainless steel manual valves (three per unit); and • Potential modification/replacement of at least one existing control valve	N/A
3	At least two low point drains per LNG Train Stabilisation Compressor unit	Figure 4
	Other activities	
1	Installation of new instruments, lighting and associated electrical cabling to tie in to the existing control system	N/A

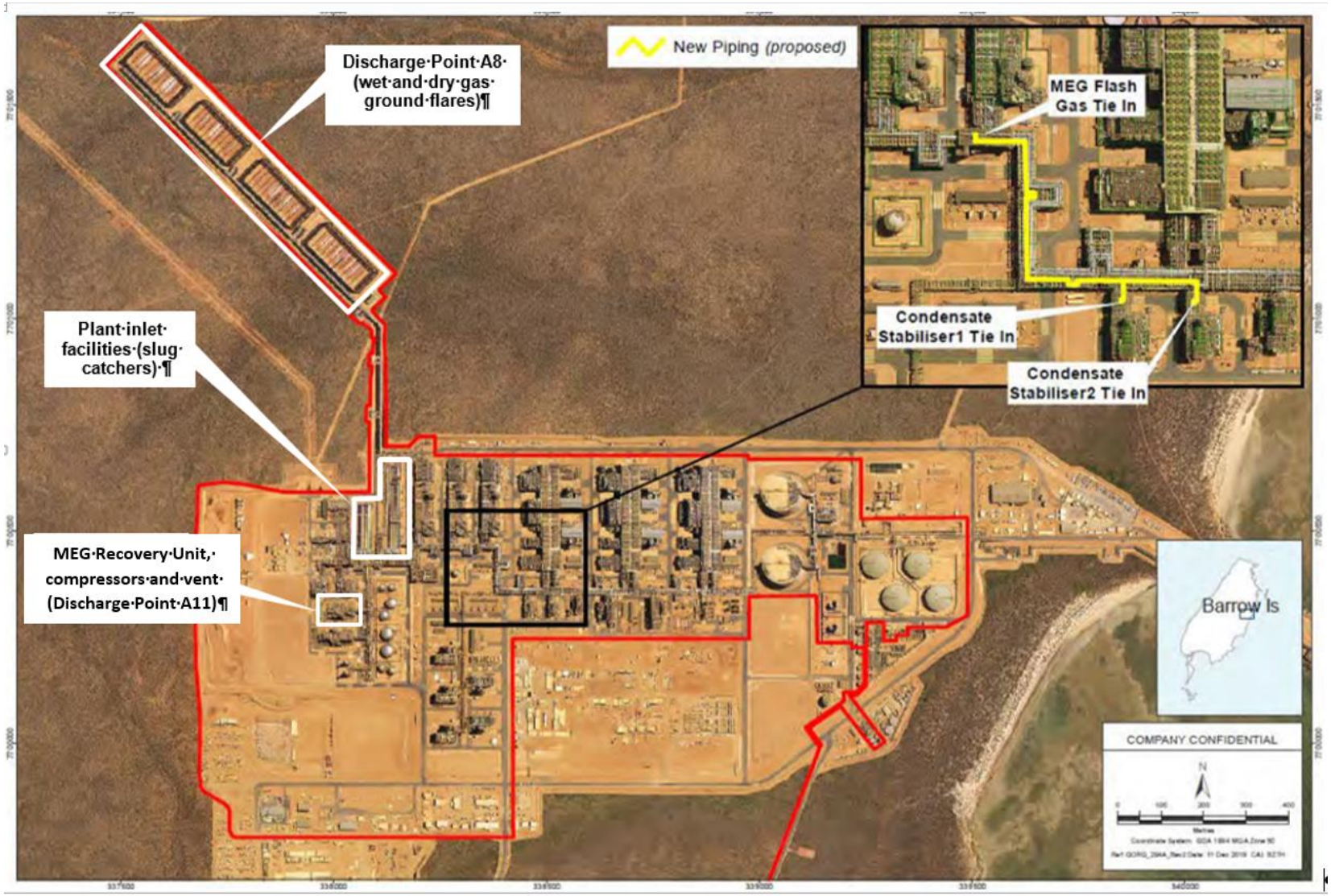

Figure 4 Site Plan - key infrastructure

4.3 Commissioning activities

The Applicant has indicated that the following commissioning activities will be undertaken:

- leak test the new piping and valves using nitrogen;
- adjustment of controllers on upstream and downstream compression units;
- function check on installed components; and
- start-up and run initial routing of MEG flash gas vapours from MEG Flash Gas Vapours Compressor to the Condensate Stabilisation Overhead Compressors.

5. Legislative context

Table 5 summarises approvals relevant to the assessment.

Table 5: Relevant approvals and tenure

Legislation	Number	Subsidiary	Approval
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	EPBC 2008/4178	Chevron Australia Pty Ltd	Conditional approval was issued for the initial two train Gorgon LNG Project on 2 October 2007 (EPBC 2013/1294). Approval for the expanded Gorgon LNG Project was issued on 26 August 2009 (EPBC 20084178). See section 5.2.3.
Barrow Island Act 2003 (BI Act) (WA) *Land Administration Act 1997 (WA)*	L007431 Volume 3158; Folio 477		The *Barrow Island Act 2003* (BW Act) and the Gorgon Gas Processing and Infrastructure Project Agreement (Schedule 1 to the BW Act) allows for the implementation of the Gorgon Gas Development and makes provision for land within the Barrow Island Nature Reserve to be used for gas processing purposes under the *Land Administration Act 1997*. Approval was received in September 2009 under section 13 of the BI Act to dispose of CO_2 by injection into the subsurface formation. Variations to the approval have been granted since the original approval.
Part IV of the EP Act (WA)	Ministerial Statement Number 800 (MS 800) EPA Reports 1221 and 1323		MS 800 was granted on 10 August 2009 and authorises the construction of facilities for the development of the Greater Gorgon Gas Fields on the North-West Shelf, and the processing and export of the gas at a liquefied natural gas plant to be constructed on Barrow Island. The Statement has undergone a number of changes under section 45C of the EP Act since it was first granted. The most recent change was approved on 3 April 2020 to amend the statement to authorise a period of temporary venting and flaring of MEG flash gas. Refer to section 5.1 below for further details.
Petroleum Pipelines Act 1969	Pipeline Licence PL 93	Gorgon Project JV partners	PL 93 was granted on 1 December 2011 and authorises the construction and operation of the Gorgon CO_2 pipeline for the conveyance and disposal of CO_2 via injection into the sub-surface Dupuy Formation subject to the terms and conditions of the licence.

5.1 Part IV of the EP Act

5.1.1 Background

The initial Gorgon Gas Development (two LNG trains) was subject to assessment under Part IV of the EP Act. Approval was granted on 6 September 2007 subject to conditions outlined in Ministerial Statement 748 (MS 748).

In September 2008, the Applicant sought both State and Commonwealth approval through a Public Environment Review (PER) assessment process for the revised and expanded Gorgon Gas Development, as outlined below:

- addition of a 5 mtpa LNG train, increasing the number of LNG trains from two to three;
- expansion of the CO_2 injection system, increasing the number of injection wells and surface drill locations; and
- extension of the causeway and the MOF into deeper water.

The revised and expanded Gorgon Gas Development was approved on 10 August 2009 (MS 800). MS 800 superseded MS 748 for the initial proposal, providing approval for both the initial Gorgon Gas Development and the revised and expanded Gorgon Gas Development.

Since the revised and expanded Gorgon Gas Development was approved, further minor changes have also been made and/or approved and updates to MS 800 made as necessary. The most recent change to MS 800 was approved on 3 April 2020 under section 45C of the EP Act. The change authorises a period of temporary venting and flaring of MEG flash gas.

5.1.2 Ministerial Statement 800

MS 800 contains conditions that need to be considered in the assessment of emissions and discharges from the Premises and the imposition of regulatory controls. These are summarised in Table 6.

Table 6: Consideration of MS 800 conditions relevant to this application

Condition	Overview	Delegated Officer considerations
1	Condition 1 requires the Proponent to implement the Proposal as described in Schedule 1 of MS 800 and subject to the conditions and any other schedules. Schedule 1 specifies that for Greenhouse Gas Emissions Abatement, improved LNG technology will include adoption of a no routine venting or flaring policy, with the exception of temporary venting and flaring of MEG flash gas until the completion of commissioning of piping to route the MEG flash vapour to the condensate stabilisation overhead unit or until 31 December 2021 (whichever is earlier), and after that time when normal operations are not available (i.e. during periods of process shut-down and start-up, and upset conditions).	Routine flaring is the flaring of hydrocarbon gas beyond that which is required for safe operation of the flare system and gas treatment plant. The application seeks to continue the combustion of MEG flash gas vapours via the wet ground flare for the period of time required to construct and commission the long-term MEG flash gas vapour capture and disposal infrastructure. MS 800 was amended on 3 April 2020 to provide exemption to the adoption of a no routine venting or flaring policy, for MEG flash gas vented or flared during the period of construction and commissioning of piping which will route the gas to the condensate stabilisation overhead unit. Venting or flaring may only occur until the completion of commissioning of the pipeline which is the subject of the Application, and flaring and commissioning must be complete by 31 December 2021 at the latest. After this time venting or flaring of MEG flash gas may only occur when the LNG Plant is not in normal operation.

Condition	Overview	Delegated Officer considerations
8	Condition 8 requires the submission of a Terrestrial and Subterranean Environmental Monitoring Program (TSEMP). The objective of the TSEMP is to '*establish a statistically valid ecological monitoring program to detect any Material or Serious Environmental Harm to the ecological elements outside the Terrestrial Disturbance Footprint'*. The TSEMP specifies procedures for monitoring vegetation, fauna (mammals and land birds), surface water landforms and groundwater, including monitoring locations, triggers and reporting.	Environmental monitoring programs described in the TSEMP have been considered in the determination of risk associated with potential emissions to air and land; however, conditions relating to environmental monitoring (e.g. monitoring of flora and fauna) will not be included on the works approval to avoid duplication.
16	A Long-term Marine Turtle Management Plan was developed in accordance with condition 16 and specifies commitments to minimise lighting and noise as far as practicable through design and operation to prevent impact on marine turtles. Procedures for monitoring lighting and impacts on turtle populations are also included.	The primary instrument for regulating the impacts on marine turtles from light and noise emissions is MS 800 and the Long-term Marine Turtle Management Plan.
26	Condition 26 sets requirements for the injection of reservoir CO_2 to an underground reservoir. The condition specifies that all practicable means shall be implemented to inject reservoir CO_2 removed during gas processing operations on Barrow Island and that at least 80% of reservoir CO_2 that would otherwise be vented to atmosphere is injected (based on a 5 year rolling average). Reservoir CO_2 is defined in MS 800 as *'a gas stream that consists overwhelmingly of carbon dioxide and coming from the acid gas removal units of the Gas Treatment Plant to be located on Barrow Island. The carbon dioxide will contain incidental associated substances derived from the natural gas and the process used to separate the carbon dioxide from that natural gas.'*	The project is designed to dispose of 100% of CO_2 via the injection system. However, prior to the construction and commissioning of the long-term solution for MEG flash gas vapours, they will continue to be directed to the wet gas flare or vented directly to atmosphere when the flare is unavailable. Impacts from future CO_2 emissions to land from implementing the long term solution for MEG flash gas vapours will be managed by the regulations set by this condition, including preparation and submission of a monitoring program that sets out how annual reporting requirements for the performance of the Carbon Dioxide Injection System (outlined in Schedule 3.6 of MS 800) will be met. Once the long-term solution to direct MEG flash gas vapours to the LNG Plant inlet facilities is implemented the CO_2 from the vapours will be disposed via the CO_2 injection system. Operation of the CO_2 injection system was assessed and approved through an amendment of the Existing Licence in July 2019 and therefore no further assessment of this activity is required.
28	Condition 28 specifies that a Best Practice Pollution Control Design Report was required to be submitted as part of the Works Approval application for the Gorgon LNG Project. The purpose of the report is to demonstrate best practice pollution control would be implemented for the Gas Treatment Plant.	An updated Best Practice Pollution Control Design Report was submitted with the works approval application to fulfil relevant EP Act Part IV requirements for the proposed works.

Condition	Overview	Delegated Officer considerations
29	An Air Quality Management Plan (AQMP) was developed under condition 29. The purpose of the AQMP is to ensure that air quality meets appropriate standards for the protection of human health and does not cause environmental harm to flora and fauna on the island. Monitoring programs for ambient air quality and point source emissions, along with committed targets, are specified in the plan.	Commitments made in in accordance with condition 29 of MS 800 will be considered as part of this Decision Report noting that the AQMP includes ambient air quality monitoring. Advice in EPA Report 1323 recommends that emissions to air (specifically NOx, O_3, SO_2 and PM_{10}) are adequately controlled under Part V of the EP Act. A revised AQMP was submitted with the Application. The AQMP was revised to take into account 2019 emissions modelling studies and monitoring data and includes ambient BTX monitoring at five locations and NOx monitoring at two locations on Barrow Island.

Key Findings:

The Delegated Officer has considered existing Part IV approvals and notes the following:

- Implementation of the original design intent for the capture and disposal of MEG flash gas vapours has been a staged process and the Application represents the final stage of works required to implement the original design of the Gorgon LNG Project.
- The MEG flash gas vapours will be directed back through the LNG plant process. Therefore mercury in the gas stream will be captured via the MRUs, the CO_2 content will be removed via the AGRUs and injected underground, and the remaining hydrocarbons will be processed.
- Condition 26 of MS 800 allows for the injection of reservoir CO_2 which is defined as coming from the AGRUs;
- There are no specific conditions relating to, or restricting the treatment and disposal of MEG gas vapour in MS 800;
- MS 800 allows for a period of temporary venting and flaring of MEG flash gas vapours. The period during which this activity is allowed ends when commissioning of the pipeline between the MEG flash gas compressor and condensate stabilisation overhead compressors is complete, and this must occur by 31 December 2021. After this time venting and flaring of MEG flash gas vapours is only authorised to occur when the LNG plant is not in normal operation; and
- The long term solution to dispose MEG flash gas vapour proposed by the Application aligns with the original design basis described in the Best Practice Pollution Control Design Report.

5.2 Other relevant approvals

5.2.1 Barrow Island Act 2003

The BI Act ratifies and authorises the implementation of an agreement between the State of Western Australia and the Gorgon joint venture parties relating to a proposal to undertake offshore production of natural gas and other petroleum, and a gas processing and infrastructure project on Barrow Island. In addition to this, the BI Act makes provisions to

enable land on Barrow Island to be used under the *Land Administration Act 1997* for gas processing project purposes. It also makes provisions as to the conveyance and underground disposal of CO_2 recovered during gas processing on Barrow Island. Minister's approval to dispose of CO_2 by injection into the subsurface formation was granted to Chevron (and Joint Venture parties) by the BI Act Minister in September 2009 (BI Act Section 13 Approval). The BI Act Section 13 Approval includes conditions which restrict the composition, daily and annual injection rate and maximum volume of reservoir CO_2 which can be injected into the Dupuy Formation.

The BI Act Section 13 Approval conditions require Chevron to comply with a CO_2 Disposal Management Plan, approved by the BI Act Minister on advice from the Department of Jobs, Tourism, Science and Innovation (DJTSI) and the Department of Mines, Industry Regulation and Safety (DMIRS), which identifies the key subsurface risks associated with the CO_2 disposal and risk management options, together with the monitoring plan which will be implemented to address the risks and demonstrate the operation of the CO_2 injection is in accordance with the requirements of the approval.

5.2.2 Department of Mines, Industry Regulation and Safety

The Premises is considered a Major Hazard Facility and is subject to the requirements of the *Dangerous Good Safety (Major Hazard Facilities) Regulations 2007*.

DMIRS regulates pipeline operations in accordance with the *Petroleum Pipelines Act 1969* (PP Act) and associated regulations. In accordance with the requirements of this legislation, oil and gas operators must submit a Safety Case (including a Safety Management System) and an Environment Plan to DMIRS to obtain approval for pipeline activities. These documents are required to demonstrate that all safety, occupational health and environmental risks and impacts associated with a pipeline activity are reduced to As Low As Reasonably Practicable and are acceptable.

Pipeline Licence PL 93 was granted to Chevron (and joint venture parties) on 1 December 2011 under the PP Act to authorise the construction and operation of the Gorgon CO_2 pipeline (and disposal facilities) for the conveyance and disposal of CO_2 via injection into the sub-surface Dupuy Formation (subject to the terms and conditions of the licence). The conditions require the Licensee to comply with the approved Safety Case and Environmental Management Plan (EMP) (construction and operation) in force.

5.2.3 *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*

The initial Gorgon Gas Development was approved by the Commonwealth Minister for the Environment and Water Resources on 3 October 2007 (Reference 2003/1294). On 26 August 2009, the Commonwealth Minister for the Environment, Heritage and the Arts issued approval for the revised and expanded Gorgon Gas Development (Reference: 2008/4178) and varied the conditions for the initial Gorgon Gas Development (Reference: 2003/1294).

Conditions imposed under the EPBC Act complement those imposed under Part IV of the EP Act relating to:

- Protection of the terrestrial and subterranean environment;
- Quarantine management;
- Fire management;
- Management of groundwater abstraction;
- Impacts associated with dredging, horizontal directional drilling and offshore pipeline installation;

- Impacts on turtles; and
- Solid and liquid waste management.

Conditions associated with CO_2 injection relate specifically to monitoring potential impacts to the Blind Gudgeon (*Milyeringa verita*); a small subterranean fish.

5.3 Part V of the EP Act

5.3.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and EP Regulations. The guidance statements that inform this assessment are specified in Appendix 1.

5.3.2 Works approval and licence history

Table 7 summarises the works approval and licence history for the premises.

Table 7: Works approval and licence history

Instrument	Issued	Nature and extent of works approval, licence or amendment
W5178/2012/1 (Inactive)	23/08/2012	New works approval for the construction of the Gorgon Gas Project LNG (Trains 1 to 3), DomGas processing trains and support infrastructure such as GTGs and flares.
	06/02/2015	Works approval amendment for the installation of additional mercury removal units, liquid mercury draw-off stations and slug catcher solids removal systems for managing higher than anticipated quantities of mercury in the feed gas.
	14/07/2016	Works approval amendment to extend the duration of the works approval to allow commissioning to be completed and to remove regulatory duplication of environmental risk associated with lighting.
L8952/2016/1 (Superseded)	14/07/2016	New licence for the operation of the Gorgon Gas Project (Train 1) and support infrastructure including DomGas processing and LNG and condensate storage.
	16/02/2017	Licence amendment to include Category 62 (solid waste depot) for the storage of waste concrete at the GTP site.
L9102/2017/1 (Current)	30/07/2018	New licence for the operation of the Gorgon Gas Project (Trains 2 and 3) consolidation of existing licenses for the Gorgon Gas Project including LNG processing trains and supporting infrastructure such as sewage treatment, waste handling and diesel storage.
	30/07/2019	Licence amendment to authorise hydrocarbon (including BTX) and hydrogen sulphide emissions to land via the carbon dioxide injection system.
W6199/2018/1	10/04/2019	Works approval to install infrastructure to collect and route MEG flash gas vapours to the wet gas flare and authorise wet flaring of MEG gas from the Premises on a temporary basis, pending the design and implementation of a long-term solution for capture and disposal of MEG flash gas vapours.
	12/12/2019	CEO initiated amendment to the works approval to remove ambiguity from Condition 6, relating to the period of time that flaring was authorised.
W6354/2020/1	8/04/2020	Works approval issued for the construction of infrastructure for long term capture and disposal of MEG flash gas vapours and to authorise flaring of MEG flash gas vapours via the ground flare until commissioning of the long term infrastructure has been completed.

5.3.3 Key and recent works approvals

Due to occupational health and safety concerns associated with venting of MEG flash gas vapours, the Applicant submitted a works approval application in 2018 to construct and temporarily operate facilities that allow MEG flash gas vapours to be routed to the wet gas flare for combustion. Works approval W6199/2018/1 was granted in April 2019 to authorise works to direct MEG flash gas vapours to the wet gas flare and undertake flaring of the re-routed gases for the period of the works approval.

Works approval W6199/2018/1 is due to expire on 10 April 2020. As the Applicant anticipates the long-term capture and disposal infrastructure will not be in operation until Q3 2021, authorisation is required through this application to continue flaring MEG vapours in the interim.

5.3.4 Key and recent licence amendments

An amendment to licence L9102/2017/1 was granted in July 2019 to authorise operation of the CO_2Injection System and to extend the premises boundary to include the CO_2 sequestration infrastructure. Once the long-term capture and disposal infrastructure proposed in this application is in operation, the Applicant proposes to direct all CO_2 separated from the MEG flash gas vapour via the AGRU (following mercury removal) to the CO_2 Injection System for sequestration.

6. Modelling and monitoring data

6.1 Modelling of air emissions

6.1.1 2019 modelling of MEG flash gas vapour emissions due to flaring

The MEG regeneration process produces a continuous stream of flash vapours containing BTX and mercury. Previous assessment (Chevron, 2017) of air emissions at the Premise included analysis of emissions modelling from the flaring of MEG flash gas vapours to predict potential ground level concentrations (GLC) of mercury and BTX. The modelling predicted that flaring would result in lower emission rates of mercury and BTX and that mercury and BTX GLCs resulting from flared MEG flash gas vapour would be ≤1% of National Environment Protection Measure (NEPM) assessment criteria at all modelled receptor locations (including within the GTP centre) and lower than GLC values predicted as a result of venting MEG flash gas vapours.

The proposed long-term infrastructure, once operational, will avoid any requirement for routine venting or flaring of MEG flash gas vapours during normal operations. Temporary flaring of these vapours until this infrastructure is commissioned will destroy approximately 98% of all BTX content and reduce BTX and mercury GLCs compared to venting which is currently authorised to occur by conditions of the Existing Licence. Emissions predicted during normal operations and upset conditions (shutdown/start-up) that are relevant to the two separate components of this works approval are summarised below.

6.1.2 Assessment of continued MEG flash gas vapour flaring

Once the piping to connect the MEG flash gas compressor output to the condensate stabilisation compressors is commissioned, there will be no emissions to air associated with MEG flash gas vapour during normal operations. However, during upset conditions (e.g. shutdown and start-ups) or unavailability of the CO_2 injection system, the MEG flash gas vapour may still need to be temporarily vented or directed to the wet gas flare. In addition, the Applicant will need to continue flaring MEG flash gas vapours until the new infrastructure is operational.

The Applicant submitted an Air Quality Assessment Report (Ramboll, 2019a) and an addendum to the report (Ramboll, 2019b) that integrated actual flaring emission rates (from 1 August 2019 to 16 December 2019) and revised GLC predictions based on the revised flaring emission rates.

The Air Quality Assessment also presented the results of modelling undertaken to predict air quality impacts associated with continued flaring of the MEG flash gas vapours.

MEG flash gas vapour flow rates to wet gas flare

The Air Quality Assessment (Ramboll, 2019a) predicted that the average and peak flow rates of MEG flash gas vapours to the flare to be approximately 0.33 kg/s and 0.67 kg/s, respectively, while the theoretical maximum design flow rate is 2.5 kg/s. However, these flow rates are considered to be conservative given monitoring of MEG flash gas vapour flow rates to the wet gas flare between August and December 2019 recorded an average flow rate of 0.14 kg/s and a maximum flow rate of 0.25 kg/s.

BTX and mercury emission rates from flaring of MEG flash gas vapours

The predicted flow rates to the wet gas flare were used to predict BTX and mercury emission rates at the flare (Table 8). The comparison indicates that the predicted BTX and mercury emission rates based on measured flow rates to the flare (collected 1 August 2019 to 16 December 2019) were an order of magnitude lower than the emission rates based on the predicted theoretical maximum design (worst case) flow rates modelled in the March 2019 report (Ramboll 2019a). The measured BTX and mercury emission rates were also significantly lower than the predicted flow rates during upset conditions. BTX and mercury emission rates in Table 8 were then modelled to predict GLCs at thirteen nominated sensitive receptor locations (

Table 9).

Table 8 Predicted BTX and mercury emission rates due to flaring of MEG flash gas vapours (g/s)

Compound	MEG Vapour Flow Rate (Wet Gas Flare)				
	March 2019 Modelling Report	Current Measured Flow Rates (1 Aug – 16 Dec 2019)		Predicted Flow Rates	
	Theoretical Design Maximum	Maximum	Average	Maximum	Average
	2.5 kg/s	0.25 kg/s	0.14 kg/s	0.67 kg/s	0.33 kg/s
	Emission rates (g/s)				
Mercury (total inorganic)	2.92E-02	2.92E-03	1.64E-03	7.83E-03	3.85E-03
Mercury (elemental)	1.46E-02	1.46E-03	8.18E-04	3.91E-03	1.93E-03
Benzene	1.38E-01	1.38E-02	7.73E-03	3.70E-02	1.82E-02
Toluene	3.34E-02	3.34E-03	1.87E-03	8.95E-03	4.41E-03
Xylene	1.43E-03	1.43E-04	8.01E-05	3.83E-04	1.89E-04

Table 9 Modelled receptor locations and their approximate distance from the emission source (ground flare).

Receptor Location	Distance from source	Receptor Location	Distance from source
GTP Centre	0.9km	Construction Village	4km
Terminal Tanks	1.7km	WA Oil Camp	4.7km
Old Airport East End	1.7km	Jetty Head	5.9km
Permanent Operational Facility	1.8km	WAPET	6.5km
Old Airport Middle	1.8km	WA Oil Base	6.9km
Old Airport West End	2.1km	Airport	9.7km
Materials Offloading Facility	3.8km		

The maximum and average GLCs predicted at any of the nominated receptor locations are presented in Table 10 as a percentage of the relevant health standard from the flaring of MEG flash vapour at the different flow rates. The results range from 0.0000001% to 1.1% of the corresponding standard.

Table 10 Predicted GLC as a percentage of applicable ambient air quality criteria (Ramboll 2019b)

Pollutant	Averaging period	Assessment criteria (µg/m^3) (NEPC, 2011)	MEG Vapour Flow Rate				
			March 2019 Modelling Report	Current Temporary Flaring (1 Aug – 16 Dec 2019)		Predicted Long-Term Processing	
			Theoretical Design Maximum	Maximum	Average	Maximum	Average
			2.5 kg/s	0.25 kg/s	0.14 kg/s	0.67 kg/s	0.33 kg/s
			GLC % of Standard				
Mercury (total inorganic)	1-hour	1.8	1.1	0.1	0.1	0.3	0.2
Mercury (elemental)	Annual	0.2	0.1	0.01	0.004	0.02	0.01
Benzene	Annual	9.6	0.01	0.001	0.001	0.004	0.002
Toluene	24-hour	3,769	0.0001	0.00001	0.00001	0.00003	0.00002
	Annual	377	0.0001	0.000009	0.00001	0.00002	0.00001
Xylene	24-hour	1,085	0.00002	0.000002	0.000001	0.000005	0.000002
	Annual	868	0.000002	0.0000002	0.0000001	0.0000004	0.0000002

The Applicant also provided raw ambient air quality monitoring data from the closest monitoring point (the Communications Tower). One hour average BTX and NOx concentrations were provided for the period 1 January 2019 to 31 December 2019. Table 11 compares the average concentrations recorded at the monitoring site before and after flaring of MEG flash gas vapours commenced on 28 July 2019. The results indicate that the average concentration for BTX decreased after flaring operations commenced, whereas NOx concentrations slightly increased.

Comparable monitoring data for mercury was also provided from a mobile air quality monitoring station that was relocated twice during 2019 for operational purposes. The data indicates average mercury concentrations have decreased following the commencement of flaring of MEG flash gas vapours.

Table 11 Comparison of BTX, mercury and NOx concentrations before and after operation of wet gas flare (ppb)

Monitoring Period	Mean 1-hour averaged concentrations				
	Benzene	Toluene	Xylene (M/P + O)	Mercury	NOx
	ppb	ppb	ppb	ng/m^3	ppb
Prior to use of flare (01/01/2019 – 30/06/2019)	0.424	0.717	0.388	10.803	2.738
During use of flare (05/07/2019 – 31/12/2019)	0.244	0.421	0.240	3.109	3.017
Concentration change	-0.181	-0.296	-0.148	-7.69	0.279

Nitrous Oxides (NOx)

Due to the low hydrocarbon content of the MEG flash gas vapour, approximately 1.7 kg/s of assist gas is required 25 per cent of the time, at the theoretical maximum design flow rate of MEG flash vapours, to ensure efficient combustion in the wet gas flare. DWER has previously assessed modelling of NOx emissions from the wet and dry ground flares undertaken for the period 12 September 2016 to 31 May 2017, based on monitored fuel consumption rates during this period. The modelling predicted maximum NOx GLCs at the Communications Tower were as low as 1 to 2 ppb, which is less than 2% of the 1-hour average NO_2 guideline of 120 ppb (Table 12). Monitoring data from the same period supported the GLC predictions.

Table 12 Measured and predicted LNG Plant NOx contribution (ppb) at the Communication Tower Monitor (12/09/2016 – 31/05/2017)

Source	No of Hours	1-hour Average Concentration (ppb)			NEPM Criteria (NEPC, 2016)
		Average	99th Percentile	Maximum	
Measured	6023	No clear discernible trend of NOx or NO_2 from ground flare area. Consider that contribution must be < 1 or 2 ppb			120
Modelled	6288	0.01	0.32	1.1	

Given the average fuel consumption rate during the 2016/2017 measurement period was 18 kg/s, an increase of 1.7 kg/s (or approximately 10 per cent) to supply assist gas for flaring at the theoretical maximum design flow rate was predicted to have a negligible impact on NOx GLCs. This prediction is supported by the average hourly NOx GLCs reported in Table 11, which slightly increased from 2.7 to 3 ppb at the Communications Tower after flaring operations commenced but remained comparable to the low concentrations reported in 2016/2017 (Table 12) and significantly below the 1-hour average NO_2 guideline level of 120 ppb.

Key Findings: The Delegated Officer has considered information relating to air emissions and has found:

- Modelling of worst case emissions from flaring MEG flash gas vapours reported in the March 2019 Air Quality Assessment Report predicted GLCs for BTX and mercury at all sensitive receptors to be well below the relevant ambient air quality standards.
- Reassessment of the modelling based on measured flow rates of MEG flash gas flared predicts GLCs at least one order of magnitude lower than of those originally modelled in March 2019.
- Monitoring data from 2019 pre and post commencement of flaring of MEG flash gas vapours indicates that flaring results in lower BTX and mercury GLCs at the monitoring station compared to venting.
- The monitoring results support the previous assessment of flaring for W6199/2018/1 that increased fuel consumption for assist gas will have negligible impact on GLCs as measured results indicate GLCs only marginally increased post-commencement of flaring and remained at levels less than 3% of the applicable NEPM human health criteria.

7. Consultation

The application for a Works Approval was made available on DWER's website for public comment from 19 February 2020 to 11 March 2020. Five letters were also sent to direct interest stakeholders inviting submissions.

Comments and responses received by DWER are presented in Appendix 2.

8. Location and siting

8.1 Siting context

The Premises is located on Barrow Island which is situated 85 km off the Pilbara coast, north-north-east of the town of Onslow and 140 km west of Karratha. Barrow Island is reserved under the Western Australian *Conservation and Land Management Act 1984* (CALM Act) as a Class A nature reserve for the purposes of '*conservation of flora and fauna'*. The Barrow Island Nature Reserve (BINR) is a unique remnant of Australia's natural ecology. The island's status as a Class A nature reserve reflects its importance as a refuge for wildlife species, with some endemic to the BINR and some extinct on the Australian mainland.

Oil production has occurred on the island since 1967. The Applicant also manages operations of the Barrow Island oil and gas facility on behalf of a separate joint venture, which includes Santos Offshore Pty Ltd, Mobil Australia Resources Company Pty Ltd, and Chevron (TAPL) Pty Ltd. The Barrow Island oil and gas facility is spread over a large portion of the island with a 4.5% footprint by land area. This facility is regulated under Licence L4467/1972/14.

8.2 Residential and sensitive receptors

The distances to residential and sensitive receptors are detailed in Table 13.

Table 13: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Butler Park (Chevron operated worker accommodation camp)	~2.5 km south of the GTP
Production Camp (Chevron operated worker accommodation camp)	~2.6 km south of the GTP
Varanus Island oil and gas facility (including workers accommodation camp)	~18 km north east of the GTP
Residential premises (Onslow)	~85 km from the GTP

Key Findings:

- In accordance with the *Guidance Statement: Risk Assessments* (DWER, 2016a), the Delegated Officer has determined that this assessment will not consider the risk of potential impacts to people in accommodation camps occupied by the Applicant. Potential impacts to people at these locations are subject to requirements under occupational health and safety regulations and obligations.
- The Butler Park and Production Camps are both operated by the Applicant (on behalf of different joint venture partners); therefore, the Delegated Officer considers that people at both camps are excluded as potential receptors.

8.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or Emissions and Discharges from the Premises. The distances to specified ecosystems and other relevant ecosystem values which do not fit the definition of a specified ecosystem are shown in Table 14.

Table 14: Environmental values

Specified ecosystems	Distance from the Premises
Managed Lands and Waters	The Gorgon Gas Project is located on the BINR is a Class A Nature Reserve Marine waters surrounding the north, west and south sides of Barrow Island form part of the Barrow Island Marine Management Area (including the Bandicoot Bay Conservation Area ~13 km to the south of the GTP). An exclusion zone exists on the east side of the island adjacent to the GTP for the Barrow Island Port Area. The Barrow Island Marine Park is located on the west side of the island (~10 km from the GTP) and incorporates the Western Barrow Island Sanctuary Area.
Threatened Ecological Communities and Priority Ecological Communities	The BINR is listed as a Priority Ecological Community. Smaller areas identified as Priority Ecological Communities are located at the GTP site as well as to the north, south and west of the Premises.
Biological component	**Distance from the Premises**
Threatened / priority flora	Three species of priority flora are located on Barrow Island west of the Premises.
Threatened / priority fauna (terrestrial and marine)	Barrow Island is recognised as an important refuge for native terrestrial mammal species that have either declined in numbers or become extinct on the mainland. A considerable number of threatened and priority fauna are known to occur on the island including a number species that are listed under the *Wildlife Conservation Act*

	1950 (WA) and the Threatened (Vulnerable) Species list of the EPBC Act. Some of these species are known to occur within or adjacent to the Premises. Green and flatback turtles (both listed as vulnerable under the EPBC Act) nest on Barrow Island. Flatback turtle rookies are recorded near the Premises (300 m away). Dugong and several species of cetaceans, fish and seabirds protected under the Biodiversity Conservation Act 2016 and/or the EPBC Act may occur in the waters surrounding Barrow Island.
Threatened / priority fauna (subterranean)	Barrow Island is recognized as being of high conservation significance for subterranean fauna communities at state, national and international levels. The subterranean fauna demonstrates high level of endemicity and species diversity and includes one of only two stygal vertebrate species occurring in Australia (Blind Gudgeon). Twelve of the species are listed under the Biodiversity Conservation Act 2016 and the Blind Gudgeon is listed as vulnerable under the EPBC Act. Thirteen stygofauna taxa were recorded in monitoring bores at the terminal tanks (approximately 1 km north of the Premises boundary).

8.4 Meteorology

8.4.1 Wind direction and strength

The Applicant maintains three meteorological monitoring stations on Barrow Island (Figure 5). Data measured at the P36 Well monitoring station between 2010 and 2014 indicates that the prevailing winds are from the south-west. During winter months (May – July), Barrow Island is subject to easterly winds.

It is important to note that these wind roses show historical wind speed and wind direction data for the P36 Well station and should not be used to predict future data.

8.4.2 Regional climatic aspects

Barrow Island is characterised by an arid, sub-tropical environment with hot summers and moderate winters. Tropical cyclone activity occurs from November to April and can generate significant rainfall.

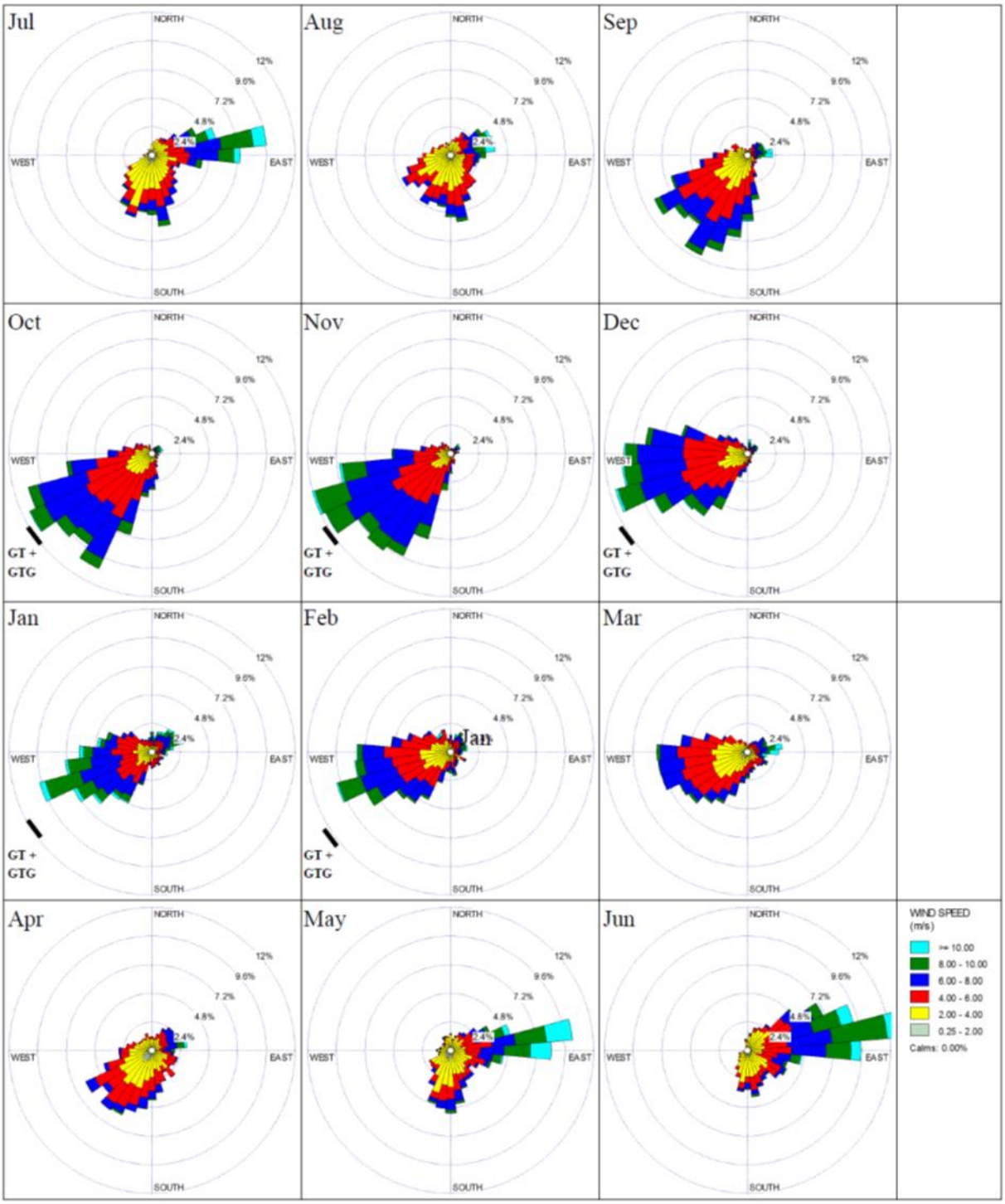

Figure 5: Wind roses by month for P36 Well meteorological monitoring site for 2010 to 2014

9. Risk assessment

9.1 Determination of emission, pathway and receptor

In undertaking its risk assessment, DWER will identify all potential emissions pathways and potential receptors to establish whether there is a Risk Event which requires detailed risk assessment.

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Table 15. The identification of the sources, pathways and receptors to determine Risk Events are also set out in Table 15 below.

Table 15. Identification of emissions, pathway and receptors

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Construction of pipeline and associated works to re-route MEG flash gas vapours	Noise Light Fugitive dust	Applicant operated accommodation camps (Butler Park and OWA Camp) (~2.5 km south) Varanus Island (~18 km northeast) Onslow (~85 km south)	Air / wind dispersion	NA	No	The minor construction works required to establish a pipeline between the MEG flash gas compressor and Condensate Stabilisation Overhead Compressors are not expected to generate significant noise, light or dust emissions and would be temporary, particularly within the scope of the existing LNG project. In accordance with the *Guidance Statement: Risk Assessments*, worker accommodation camps are not considered a potential receptor. The Delegated Officer has determined that there is sufficient separation distance to other sensitive receptors for there to be no source-pathway-receptor link.

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
	Noise Light	Turtle nesting beaches located 300m away		Disruption to turtle nesting behaviour.		The minor construction works are not expected to generate significant noise or light emissions and would be temporary, particularly within the scope of the existing LNG project. The Delegated Officer has determined that potential impacts on marine turtles from noise and light are regulated under MS 800 (condition 16) via the Long Term Marine Turtle Management Plan.
Continuation of flaring MEG flash gas vapours for up to 20 months until long-term capture and disposal infrastructure is operational. Temporary flaring or venting during shutdown conditions once long-term capture and disposal infrastructure is operational.	Light	Turtle nesting beaches located 300m away	Air / wind dispersion	Disruption to turtle nesting behaviour.	No	The Delegated Officer has determined that impacts on marine turtles from light are regulated under MS 800 (condition 16) via the Long Term Marine Turtle Management Plan.
	Noise	Applicant operated accommodation camps (Butler Park and OWA Camp) (~2.5 km south) Varanus Island (~18 km northeast) Onslow (~85 km south)	Air / wind dispersion	N/A	No	In accordance with the *Guidance Statement: Risk Assessments*, worker accommodation camps are not considered a potential receptor. BINR is considered one premises for the purpose of the *Environmental Protection (Noise) Regulations 1997*; therefore, the specified limits in the regulations do not apply to the accommodation camps. The Delegated Officer has determined that there is sufficient separation distance to other sensitive receptor for there to be no source-pathway-receptor link.
		Turtle nesting beaches located 300m away		Disruption to turtle nesting behaviour.	No	The Delegated Officer has determined that potential noise impacts on marine turtles are regulated under MS 800 (condition 16) through the Long Term Marine Turtle Management Plan.

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
	Combustion gases (NOx) Mercury BTX	Applicant operated accommodation camps (Butler Park and OWA Camp) (~2.5 km south) Varanus Island (~18 km northeast) Onslow (~85 km south)	Air / wind dispersion	N/A	No	In accordance with the *Guidance Statement: Risk Assessments*, worker accommodation camps are not considered a potential receptor. The Delegated Officer has determined that there is sufficient separation distance to other sensitive receptors for there to be no source-pathway-receptor link. While the camps have not been considered a potential receptor, comparison of predicted pollutant GLCs based on theoretical and measured MEG flash gas flaring flow rates were considered by the Delegated Officer in Section 6.1 and found to be a maximum of 2% of the ambient air quality criteria. Specifically, the maximum predicted BTX concentrations were 0.01% of the relevant health criteria, maximum mercury concentrations were 1.1% of the criteria and maximum NOx concentrations were 2% of the criteria. Therefore, the risk of health impact associated with these emissions is low.

		Flora and fauna within the Class A Nature Reserve		Survival and health impacts to flora and fauna	No	In their assessment (EPA Report 1323), the EPA noted the lack of data available on the effects of air pollutants on fauna and flora. In the absence of standards, the EPA considered that limits for humans were the only available surrogate standards for mammals and that the deposition limits described in the World Health Organisation Air Quality Guidelines for Europe (WHO, 2005) were an appropriate surrogate for assessing the impact of air pollutants on vegetation. The Delegated Officer has determined that flaring of the MEG flash gas vapour does not increase the risk associated with emissions to air assessed for Licence L9102/2017/1, which was determined to be 'medium' based on a 'minor' consequence rating and 'unlikely' likelihood rating . Further, based on the 2019 modelling of emissions associated with flaring of MEG flash gas vapours, at a theoretical maximum flow rate of 2.5g/s, it was determined that mercury and BTX emissions would be reduced compared with venting of emissions from the compressor (which is currently authorised under the licence). The predicted emissions would result in maximum GLCs that are less than 2% of NEPM criteria. The Delegated Officer therefore considers the continued flaring of the MEG flash gas vapour for up to 20 months to be low risk. Actual sampled flow rates from the flare have been significantly lower than the modelled rate of 2.5 g/s since it commenced operation in July 2019. Modelling based on these actual flow rates (and maximum flow rates) predicts that mercury and BTX GLCs are further reduced when compared to the venting scenario and considerably lower (≤0.3%) than relevant health criteria. In addition, 2019 monitoring data from the nearest monitoring location indicated that measured concentrations of BTX and mercury are significantly reduced during flaring compared to venting (although NOx concentrations marginally increased). A calorific value analyser is installed on the wet gas flare feed line ensuring that the calorific value of the gas going to the wet flare does not fall below vendor specifications to ensure efficient combustion of the MEG flash gas vapours. Monitoring of the volume of gas flared is also monitored in accordance with condition of Licence L9102/2017/1. Ongoing ambient air quality monitoring undertaken in accordance with the AQMP developed under MS 800 will continue to verify ambient air quality, including BTX and NOx levels, are meeting relevant air quality criteria during the duration

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
						of the flaring activity. Implementation of the TSEMP developed the requirements of Condition 8 of MS 800 to measure impacts on flora and fauna is considered to be a suitable regulatory control for detecting and responding impacts on flora and fauna associated with flaring of MEG flash gas vapours.
Emissions to land via Carbon Dioxide Injection System (long-term routine operations)	Hydrocarbon (including BTX) CO_2	Groundwater dependant ecosystems - subterranean fauna (including the Blind Gudgeon) Flora and fauna within the Class A Nature reserve Groundwater (shallow unconfined fresh water aquifer)	Seepage to surface or subsurface environments	Survival and health impacts to stygofauna, flora and fauna	No	The Delegated Officer has determined that injection of CO_2 and hydrocarbon including BTX to the Dupuy Formation via the existing CO_2 injection system has been assessed and approved under the Existing Licence to the maximum authorised limits. Impacts to the listed receptors were considered in the assessment. The addition of emissions from the MEG flash gas vapours will not exceed the already authorised limits therefore no further assessment is required of this activity. Mercury will be captured and removed via mercury removal units therefore is not authorised for discharge to land via the CO_2 injection system.
Commissioning of long-term infrastructure – nitrogen emissions to land via Carbon Dioxide Injection System	Nitrogen (used for leak testing)	Groundwater dependant ecosystems - subterranean fauna (including the Blind Gudgeon) Flora and fauna within the Class A Nature reserve Groundwater (shallow unconfined fresh water aquifer)	Seepage to surface or subsurface environments	Survival and health impacts to stygofauna, flora and fauna	No	The Delegated Officer has determined that no additional risks are associated with nitrogen emissions from this process given injection of nitrogen has previously been excluded from assessment in the Decision Report for L9102/2017/1. The exclusion was based on the proposed maximum concentration of nitrogen within the gas stream being at a level (<1,000 ppm) not considered to present a risk of pollution. .

10. Regulatory controls

10.1 Works Approval conditions

The works approval authorises the proponent to undertake works, subject to conditions, to construct infrastructure which will re-route MEG flash gas vapours to the LNG Plant Condensate Stabilisation Overhead Compressors and to temporarily continue the flaring of MEG flash gas vapours while the works are completed and commissioned. Therefore, controls to be implemented under this works approval relate only to the installation of long-term infrastructure and the continued period of temporary flaring. The works approval is also limited to a period of 20 months only which has been based on estimated timeframes provided by the applicant for completion of construction and commissioning of the works and to align with the maximum timeframe that temporary flaring of MEG flash gas vapour is authorised to occur in accordance with MS 800 (refer to section 5.1.2).

The conditions in the issued Works Approval in Appendix 3 have been determined in accordance with the *Guidance Statement: Setting Conditions* (DWER, 2015). The *Guidance Statement: Licence Duration* (DWER, 2016b) has also been applied and the issued Works Approval expires in 20 months from date of issue. Table 16 provides a summary of the conditions to be applied to this Works Approval.

Table 16: Summary of conditions to be applied

Condition Ref	Grounds
Infrastructure and Equipment Installation Condition 1	This condition is valid, risk-based and consistent with Section 62A(1)(a) and (b) of the EP Act.
Environmental Compliance Condition 2 and 3	Environmental compliance is a valid, risk-based condition to ensure appropriate linkage between the Works Approval and the EP Act.
Infrastructure Commissioning Condition 4, 5, 6 and 7	These conditions are valid, risk-based and enable flexibility in operations.
Emissions Condition 8, 9 and 10	This condition is valid, risk-based and consistent with the EP Act.
Records and Reporting Condition 11, 12, 13, 14 and 15	These conditions are valid and are necessary administration and reporting requirements to ensure compliance.

DWER notes that it may review the appropriateness and adequacy of controls at any time and that, following a review, DWER may initiate amendments to the Works Approval under the EP Act.

10.1.1 New infrastructure installation and commissioning

Condition 1 specifies design and installation requirements relating to the long-term infrastructure works detailed in Section 4.2 of this report. Standard controls will be set on the design and installation requirements of new infrastructure in accordance with Section 62(A) of the EP Act. Conditions 2 and 3 cover compliance reporting to validate that the new infrastructure is installed as per the requirements in Condition 1 with certification by a suitably qualified professional engineer.

The commissioning phase will be regulated by Conditions 4, 5, 6, 7and 8. These conditions set out the environmental commissioning tasks, timeframes and reporting requirements necessary to provide evidence that the new infrastructure if fit for purpose. The conditions

include a notification requirement (Condition 6) to ensure the CEO is advised when environmental commissioning has been completed, as authorisation for time-limited operations (flaring of MEG flash gas vapours via the ground flare) ceases at the completion of the environmental commissioning.

10.1.2 Time-limited operations

Conditions 9, 10 and 11 set out controls identifying infrastructure which can be operated during time-limited operations; the authorised emissions associated with flaring of MEG flash gas vapours (NOx, SOx, CO, VOC [including BTX], PM and Hg); the permitted discharge point locations; the timeframe permitted for operation of infrastructure; and emissions discharged as a result of the flaring of MEG flash gas vapour. The timeframe is based on the maximum timeframe that temporary flaring of MEG flash gas vapour is authorised to occur in accordance with MS 800 (refer to section 5.1.2). These controls provide a clear timeframe during which the Applicant may conduct time-limited operations using existing infrastructure to route MEG flash gas vapour to the ground flare system for combustion and discharge, and ensure that the existing infrastructure is maintained to allow this activity.

10.1.3 Records and reporting

All records and additional reporting requirements are outlined in Condition 12, 13, 14, 15 and 16. Given implementation of the long term solution for capture and disposal of MEG flash gas vapours, which was part of the original design basis for the LNG Project, has already been delayed, DWER wishes to prevent further delay to the completion of these works. Conditions have therefore been included requiring the Applicant to submit quarterly Progress Reports throughout the duration of the works approval to provide updates on the works completed in the preceding three months, key milestone dates and any issues that may impact those dates (Condition 12 and 13). This will inform DWER of any potential drift in the planned commissioning and operation timeframes provided by the Applicant and reduce the risk of potential delays. Reporting of complaints is specified by Condition 14.

10.2 Licence conditions

The Existing Licence authorises venting of emissions from the MEG flash gas compressor. When the pipeline routing the MEG flash gas vapours from the MEG flash gas compressor to the Condensate Stabilisation Overhead Compressors is operational, venting or flaring of the vapours will only be required when the CO_2 Injection System and/or the Inlet and MEG regeneration/condensate stabilisation systems is are not available due to upset conditions, shutdowns or start-ups. Conditions will be amended on the licence to specify venting or flaring is only authorised to occur during such conditions.

The monitoring of air emission concentrations at the authorised discharge point (flare) is considered to be unsafe. Given air emissions (including BTX and NOx concentrations) are to be monitored at receptor locations through existing monitoring programs developed in accordance with requirements set in MS 800, no further monitoring is recommended for the licence to avoid regulatory duplication. In addition, the volume of MEG flash gas vapours discharged via the flare or vent will continue to be monitored in accordance with Schedule 3 in the Existing Licence and this data can be used to verify that flaring or venting is only occurring as required during upset conditions, once the long-term infrastructure is in operation.

An amendment to the Existing Licence was granted on 30 July 2019 that led to the inclusion of conditions associated with the operation of the CO_2 Injection System. The assessment considered the maximum volume of reservoir CO_2 authorised to be disposed via the injection system as per the BI Act. The amendment resulted in the addition of emission points for discharge of hydrocarbons (including BTX) to land via the CO_2 injection wells (Condition 7) and limits on the total injection rate and composition of injected hydrocarbons (including BTX)

(Condition 8). Given that the re-routing and processing of MEG flash gas vapours will only result in a relatively minor increase in reservoir CO_2 and therefore the volume to be discharged is expected to remain significantly below the authorised limit, no changes to the relevant conditions in the Existing Licence are recommended.

11. Applicant's comments

The Applicant was provided with the draft Decision Report and draft issued Works Approval on 3 April 2020. The Applicant provided a response on 6 April 2020 which included clarification of some minor technical aspects in the Decision Report and the infrastructure which will be constructed under the Works Approval.

12. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this

Based on this assessment, it has been determined that the Works Approval will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

James Milne

A/Senior Manager, Process Industries
Delegated Officer

under section 20 of the *Environmental Protection Act 1986*

Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Application form: Works Approval	Chevron, 2020a	DWER records
2.	Licence L9102/2017/1 – Gorgon Gas Development	L9102/2017/1	DWER records
3.	Works Approval W6199/2018/1 - Gorgon Gas Development	W6199/2018/1	DWER records
4.	Chevron Australia Pty Ltd, 2020b. Best Practice Pollution Control Design Report.	Chevron, 2020b	DWER records
5.	Email correspondence: Part V (Overview of the flare/purge system). Chevron Australia Pty Ltd	Chevron, 2020c	DWER records
6.	Ramboll, 2019a. MEMO: Gorgon MEG Flash to Flare. 29 March 2019	Ramboll, 2019a	DWER records
7.	Ramboll 2019b. Gorgon MEG Flash to Flare Technical Note. 20 December 2019	Ramboll 2019b	DWER records
8.	Chevron Australia Pty Ltd, 2017. *Gorgon Project Emissions Verification Report: LNG Trains 1, 2 and 3 and Associated Facilities (W5178/2012/1)*	Chevron, 2017	DWER records
9.	National Environment Protection Council (NEPC), 2011. National Environmental Protection (Air Toxics) Measure	NEPC 2011	Available online at: https://www.legislation.gov.au/
10.	National Environment Protection Council (NEPC), 2016. National Environmental Protection (Ambient Air Quality) Measure	NEPC 2016	
11.	Ministerial Statement 800	MS 800	Available online at: www.epa.wa.gov.au/
12.	DWER, October 2015. *Guidance Statement: Setting conditions*. Department of Environment Regulation, Perth.	DWER 2015	Available online at: www.dwer.wa.gov.au
13.	DWER, November 2016. *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.	DWER 2016a	
14.	DWER, August 2016. *Guidance Statement: Licence duration.* Department of Environment Regulation, Perth.	DWER 2016b	

Appendix 2: Summary of stakeholder comments on the application

Summary of Stakeholder comments	DWER response
The stakeholder alluded to the extension to temporarily continue flaring MEG gas for approximately 12 – 18 months longer than originally contemplated in the previous works approval W6199/2018/1, assuming that no further delays occur. The stakeholder submits that this extension will result in significant uncontrolled/excess emissions from the Premises into the atmosphere that were not originally contemplated to occur and is another example of the proponent pushing out the timeframe for which it will continue to emit various substances into the atmosphere before they will be properly disposed of through the CO_2 Injection System. The stakeholder therefore proposes that DWER require the proponent to expedite the timeframe for implementation of the long-term disposal method of MEG gas, or at a minimum to require it to rigorously justify the extension of the period and explain why it cannot implement the disposal method more quickly. The stakeholder also requested that the final works approval should also require the proponent to implement the long-term disposal method of MEG gas as soon as possible.	The Decision Report for works approval W6199/2018/1 concluded that there were no risks requiring detailed assessment relating to the operation of infrastructure to direct MEG flash gas vapours to the wet gas flare, at a theoretical maximum flow rate of 2.5 kg/s. The 2019 modelling assessments have since indicated that actual sampled flow rates from the flare have been significantly lower. The modelling also predicted that mercury and BTX GLCs based on these actual flow rates (and maximum flow rates) are reduced when compared to the venting scenario and considerably lower than relevant health criteria. In addition, 2019 monitoring data from the nearest receptor location indicated that flaring of the MEG flash vapour results in BTX and mercury GLCs significantly below relevant health criteria at the nominated sensitive receptor locations. The Delegated Officer has therefore determined that the continued flaring of the MEG flash gas vapour for a limited period of up to 20 months is low risk. In addition, imposing an expedited timeframe to complete the installation would introduce unnecessary health and safety risks to workers. The priority for DWER is that the works are completed safely and competently in accordance with the proponent's design requirements and requested timeframe.
The Department of Biodiversity, Conservation and Attractions (DBCA) responded to the letter issued by DWER inviting submissions on the Applications by confirming they had no	Noted no response required.

Summary of Stakeholder comments	DWER response
comment.	
The Department of Mines, Industry Regulation and Safety (DMIRS) responded to the letter issued by DWER inviting submissions on the Applications by confirming they had no comment.	Noted no response required.
The Shire of Ashburton responded to the letter issued by DWER inviting submissions on the Applications by confirming they had no comment.	Noted no response required.

Appendix 3: Works Approval W6354/2020/1